

# The Scales of Measurement

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## 1 Scales of Measurement

Scales of Measurement are similar to levels of measurement, but they are often used interchangeably in statistical discussions. These scales help identify the type of data you are dealing with and guide you in choosing appropriate analysis methods. The scales of measurement are Nominal, Ordinal, Interval, and Ratio, each corresponding to a level of measurement, but here they are discussed with more focus on scaling and how the data is structured and represented.

### 1.1 Nominal Scale

- Definition: The nominal scale is used for data that is categorized into distinct groups, where there is no inherent order or ranking between the categories. The data simply provides labels or names to distinguish different groups.
- Characteristics:
  - No quantitative value.
  - Data can only be classified or counted.

- Categories are mutually exclusive and exhaustive.
- Examples:
  - Eye color: Blue, Green, Brown.
  - Marital status: Single, Married, Divorced.
  - Types of pets: Dog, Cat, Bird.
- Operations Allowed:
  - Comparison: Can determine if items are the same or different.
  - Counting: Can count the frequency of categories.
- Key Uses: Frequency distribution, mode, Chi-square test.

## 1.2 Ordinal Scale

- Definition: The ordinal scale classifies data into categories that have a meaningful order or ranking, but the differences between these ranks are not necessarily equal or meaningful.
- Characteristics:
  - Data is ranked or ordered, but intervals between ranks are not standardized.
  - Allows for comparison between data points, but not the magnitude of differences.
- Examples:
  - Customer satisfaction: Very Unsatisfied, Unsatisfied, Neutral, Satisfied, Very Satisfied.
  - Class ranking: 1st, 2nd, 3rd.
  - Education level: High school, Bachelor's, Master's, Doctorate.
- Operations Allowed:
  - Comparison: You can say one item is greater or lesser than another.
  - Rank: Can order the data, but can't calculate meaningful differences between them.
- Key Uses:
  - Median, percentiles, non-parametric statistical tests (e.g., Spearman's rank correlation).

### 1.3 Interval Scale

- Definition: The interval scale not only orders data but also measures the difference between data points in equal intervals. However, there is no true zero point, meaning zero does not indicate the absence of the variable being measured.
- Characteristics:
  - Equal intervals between values.
  - Can perform arithmetic operations like addition and subtraction.
  - No true zero (e.g., 0 degrees Celsius does not mean “no temperature”).
- Examples:
  - Temperature in Celsius or Fahrenheit.
  - IQ scores.
  - Calendar years: 2000, 2010, 2020.
- Operations Allowed:
  - Addition/Subtraction: Differences between values are meaningful.
  - Cannot calculate meaningful ratios (e.g., 20°C is not “twice as hot” as 10°C).
- Key Uses:
  - Mean, standard deviation, correlation, parametric statistical tests.

### 1.4 Ratio Scale

- Definition: The ratio scale is the most advanced level of measurement, where data not only have equal intervals between values but also have an absolute zero point, indicating the complete absence of the variable being measured. This allows for all arithmetic operations, including multiplication and division.
- Characteristics:
  - Equal intervals between data points.
  - True zero point (e.g., 0 kg means no weight).
  - Ratios between numbers are meaningful.

- Examples:
  - Weight: 0 kg, 50 kg, 100 kg.
  - Height: 0 cm, 150 cm, 200 cm.
  - Time: 0 seconds, 30 seconds, 60 seconds.
  - Income: \$0, \$50,000, \$100,000.
- Operations Allowed:
  - All arithmetic operations: Addition, subtraction, multiplication, and division.
  - Ratios are meaningful (e.g., someone earning \$100,000 earns twice as much as someone earning \$50,000).
- Key Uses:
  - Geometric mean, all parametric statistical tests (ANOVA, regression, t-tests).

### 1.5 Summary of Scales of Measurement:

Scale	Definition	Examples	Key Features	Allowed
Nominal	Categorizes data without a meaningful order.	Gender, Hair Color, Types of Pets	Categorical data, no order, no arithmetic	Counting, frequency, mode
Ordinal	Ranks data in an order, but differences between ranks are not equal.	Satisfaction Ratings, Class Rank	Ordered categories, unequal intervals	Median, percentiles, comparison of ranks
Interval	Orders data with equal intervals, but no true zero.	Temperature (Celsius), IQ Scores	Equal intervals, no true zero	Addition, subtraction, mean, standard deviation
Ratio	Orders data with equal intervals and a true zero, allowing meaningful ratios.	Weight, Height, Time, Income	Equal intervals, true zero, meaningful ratios	All arithmetic operations (addition, subtraction, multiplication, division)

Figure 1: Summary Table

### 1.6 Conclusion:

Understanding the scales of measurement is crucial for selecting appropriate statistical methods and interpreting data correctly. By identifying the scale of your data, you can determine the types of analyses that are suitable and avoid making incorrect assumptions about the nature of your variables. Remember that the scale of measurement is not fixed and can change depending on how data is collected and analyzed, so it is essential to consider the context and purpose of your study when determining the scale of your variables.